

# The Tinguiririca Fauna, Chile: biochronology, paleoecology, biogeography, and a new earliest Oligocene South American Land Mammal 'Age'

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## Abstract

A new South American Land Mammal 'Age' (SALMA), the Tinguirirican, is formally established, based on an assemblage of at least 25 taxa from the Chilean Andes (and smaller correlative faunas from Argentine Patagonia) that lies near the Eocene–Oligocene transition. Tinguirirican faunas occur within a previously poorly sampled temporal interval, a significant gap in the SALMA succession, accounting for the very high percentage of taxa that are new. The Tinguirirican includes a suite of taxa not documented to co-occur elsewhere. It is defined by the first stratigraphic occurrences of taxa known elsewhere only from younger beds: caviomorph rodents; interatheriine interatheriids; an otherwise Deseadan and younger clade of notohippids, diagnosed by hypsodont lower incisors; the clade of archaeohyracids including those taxa more closely related to Archaeohyrax than to Pseudohyrax; leontiniids; and the clade of groeberiid marsupials stemming from the most recent common ancestor of Klohnia and Patagonia. Among its numerous noteworthy occurrences, the Tinguiririca Fauna includes the earliest rodents known from South America (documenting that caviomorphs had reached the continent near or before the Eocene/Oligocene boundary, with an African origin for the clade – based on preliminary phylogenetic analysis), an unusual diversity of therian species possessing a 'gnawing' dentition, and the world's oldest mammalian herbivore assemblage dominated by species with hypsodont cheek teeth. The Tinguirirican assemblages indicate that Simpson's 'Second Faunal Stratum' began considerably earlier (prior to the Deseadan) than previously thought. The stratotype sequence for the Tinguirirican SALMA assemblage in Chile has yielded high-precision  $^{40}\text{Ar}/^{39}\text{Ar}$  radioisotopic dates, as have underlying non-fossiliferous beds. These indicate that the fauna is at least ~31.5 Ma in age. While it potentially spans a range as large as 31–37.5 Ma or more, various lines of evidence hint that this SALMA is probably of short duration (possibly less than 2 m.y.). Body size distributions (cenograms), dental hypsodonty levels, and macroniche categories are employed to infer paleoenvironmental conditions for the Tinguiririca Fauna. Collectively, these analyses reveal some non-analog aspects of middle Cenozoic South American localities relative to modern systems; that an open, relatively dry habitat (with a mean annual rainfall of 1100 mm or less) was present at Tinguiririca, and that the most dramatic shift in Cenozoic South American paleoecology and paleoenvironment occurred between the Mustersan and Tinguirirican SALMAs. Additionally, the Tinguiririca Fauna is the first Cenozoic mammal assemblage dominated by hypsodont taxa (at levels dramatically higher than those of preceding times). The proportion of hypsodont taxa in modern assemblages correlates positively with the amount of open habitat, indicating that open habitat grassland/woodland environments flourished 15–20 million years earlier in South America than on other continents. Indeed, the Tinguiririca Fauna exhibits a proportion of hypsodont taxa exceeding even that seen in modern open habitats. Such faunas and habitats thus occur in very close proximity to the Eocene/Oligocene boundary and earliest Oligocene climatic 'deterioration', and their associated paleoclimatic and paleoenvironmental events. The mid-latitude Tinguiririca Fauna suggests complex biogeographic patterns during the early–middle Cenozoic – while it is decidedly 'Patagonian' in taxonomic composition, several members of the fauna hint at close affinities with lower latitude assemblages.

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